Use of unique or non-traditional feeds: Are we revisiting old school feedlot diets?

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Introduction

Corn prices have been variable the past few years and generally more expensive. As a result, we have initiated a few different research programs to address these needs. Early on, grain was expensive ($5/bu or more), distillers grains (wet or modified) were relatively inexpensive as a percentage of grain price (70 to 90% on a dry-to-dry basis), and corn residue (baled stalks) were relatively inexpensive ($50 to $70/ton). As a result, research focused on how to use more residue and distillers grains and less corn grain. Two research areas were evaluated: alkaline treatment of corn stalks and increasing use of corn silage as methods to decrease corn usage. The questions were if you decrease corn inclusion, will performance be maintained or will feed conversion get worse. Even with some depression (increase) in F:G, will cost of gain be more competitive.

More recently, price of corn has moderated compared to historical highs ($4/bu), price of distillers grains has increased relative to corn (100 to 140% price of corn, depending on location and timing), and residue has stayed relatively constant in price ($50-$70/ton). As a result, things are different.

Our assessment is that each crop year may be different and appears to impact the optimum approach for feeders. Having research that "applies" to these various scenarios is helpful for sound decision making. Of course, the breakeven on cattle is impacted the most by purchase price of incoming feeder cattle for feedlots. Given current industry statistics, tight cattle supplies will be the economic driver in the near future. This situation of tight cattle supplies and expensive feeders doesn't diminish the importance of feed costs, in fact, the current situation suggests feed costs may be more critical than in the past due to the large investments now required to buy and finish cattle.

Alkaline treated corn stalks

We have conducted a series of studies over the past 4 years focused on alkaline treatment of corn stalks (and wheat straw) to enhance its digestibility and then feed at greater than "normal" to replace a small portion of corn grain. A large amount of research data are available from the 1970s where different alkaline treatments were evaluated to make low quality forages more digestible. Some chemicals are stronger than others, but the focus of our research has been on using calcium oxide, which is converted to calcium hydroxide in water, to alkaline treat the residues. Calcium oxide was most logical in our opinion as it provides needed calcium in feedlot diets, it is less caustic than some alternatives, and the oxide form produces some heat when converted to hydroxide in water which may be beneficial. We have not compared calcium oxide to hydroxide in these settings.

We have conducted six feedlot pen studies, two growing cattle pen studies, one individually fed finishing experiment, and one feedlot digestion experiment. In the initial feedlot study, we compared treated corn stalks, wheat straw, or corn cobs with 5% calcium oxide to untreated or native stalks, straw, or cobs and fed these at 20% of the diet DM (Shreck et al., 2012a). All diets also included 40% wet distillers grains plus solubles (WDGS). We also included a control diet that had 10% native forage as a blend of the 3. Compared to the control with 10% roughage, gains and feed conversion (F:G) were the same when 20% treated forage was fed compared to 10% native. For straw and stalks, cattle fed 20% native residue gained less and had poorer (i.e., greater) F:G. Two studies were conducted with calf-feds or summer-fed yearlings and designed similarly whereby 20% treated, 20% native, and 5% native corn stalks were fed with 40% modified distillers grains plus solubles (MDGS) on a DM basis (Johnson et al., 2013). Calf-feds fed 20% treated stalks had similar ADG and F:G as control fed steers, and both were better than feeding 20% untreated stalks as you would expect (Table 1). For summer fed yearlings, steers fed 20% treated stalks had numerically lower (but statistically similar) ADG and poorer F:G than control fed steers, but much better than feeding 20% native stalks (Table 1).

Table 1. Finishing performance and carcass characteristics of calf-fed or yearling steers fed 5% stalks (CON), or 20% stalks (NONTRT) or 20% alkaline treated stalks (TRT). (Johnson et al., 2013)

Diet	CON	NONTRT	TRT	P - value
Calf-feds				
DMI, lb/d	22.4	22.9	22.4	0.42
ADG, lb[1]	3.67[a]	3.24[b]	3.61[a]	<0.01
F:G[1]	6.36[a]	7.05[b]	6.22[a]	<0.01
HCW, lb	860[a]	812[b]	854[a]	<0.01
Dressing %	63.3[a]	62.0[b]	63.6[a]	<0.01
12th Rib Fat, in	0.51	0.41	0.48	0.07
Marbling[2]	582[a]	532[b]	551[a]	<0.01
Yearlings				
DMI, lb/d	26.8[a]	28.8[b]	27.6[a]	<0.01
ADG, lb[1]	4.18[a]	3.77[b]	4.04[a]	<0.01
F:G[3]	6.42[a]	7.65[b]	6.85[c]	<0.01
HCW, lb	914[a]	878[b]	901[a]	<0.01
Dressing %	62.8[a]	60.9[b]	61.3[c]	<0.01
12th Rib Fat, in	0.59	0.53	0.57	0.16
Marbling[2]	574	537	556	0.09

[a, b, c] Means within a row with unlike superscripts differ ($P< 0.05$).
[1] ADG based on carcass-adjusted final BW = HCW/0.63.
[2] Marbling: 500 = small0, 600 = modest0.

To test this futher, a commercial study was conducted whereby the control diet (6% stalks along with 35% WDGS were compared to feeding 20% treated stalks. Steers had similar DMI between treatments ($P = 0.23$). On a live basis, steers fed TRT were 19 lb numerically lighter ($P = 0.19$) in shrunk live BW at the end of the feeding period compared to CON (Table 2). As a result, ADG was decreased by feeding TRT compared to CON ($P = 0.06$) and cattle were less efficient ($P = 0.01$), with a 0.20 increase in F:G. Carcass weights were 20 lb lighter ($P = 0.04$) for TRT fed steers compared to CON. Therefore, when performance was adjusted for 63% dress final BW, ADG was decreased ($P < 0.01$) by 0.20 lb/d for TRT compared to CON. Less gain resulted in poorer F:G for TRT steers compared to CON ($P < 0.01$). There was a significant block by treatment interaction for carcass-adjusted ADG, which was tested due to 4 replications per block. Feeding TRT decreased ADG by 0.32 lb/d in block 1 (northern cattle) whereas ADG only decreased by 0.06 lb/d in block 2 (Mexican cattle) compared to CON. As a general rule, feeding TRT resulted in lighter carcasses, and lower dressing percentage. With no change in intake, the decrease in ADG resulted in poorer feed conversions and some subtle impacts on carcass quality, which reflect poorer ADG.

Table 2. Performance and carcass characteristics of commercial feedlot steers fed either alkaline treated corn stover at 20% of diet DM (TRT) or a conventional control with 6% stover (CON) blocked by two different types of steers and arrival date (Cooper et al., 2014).

	CON	TRT	P-value
PERFORMANCE			
DMI, lb/d	23.36	23.58	0.53
Live			
Final BW, lb	1372	1353	0.19
ADG, lb	4.04	3.94	0.06
F:G	5.79	5.99	0.01
Carcass-adjusted			
Final BW, lb	1401	1370	0.04
ADG, lb	4.25	4.05	<0.01
block 1	4.68	4.36	
block 2	3.81	3.75	
F:G	5.53	5.83	<0.01
CARCASS CHARACTERISTICS			
Hot Carcass Weight	882.8	862.9	0.04
Fat Depth	0.51	0.49	0.07
Ribeye Area	13.3	13.1	0.11
Yield Grade	3.29	3.21	0.29
Quality Grade Distribution			
% Prime	0.45	0.30	0.53
% Choice	57.94	51.74	0.02
% Select	38.66	42.64	0.09
% < Standard	2.95	5.33	0.14

[1] P-values for effect of diet (CON vs TRT). P-values for block and interaction between block and diet are in the original publication.

In these studies, stalks were ground through a 3-in. screen and tub ground prior to treating. We wanted to evaluate feeding stalks ground through either a 1 in. or 3 in. screen to determine the impact of forage grind size on the treatment process and effectiveness. While cattle fed a 1 in. grind did slightly better (numerically) in terms of ADG and F:G compared to the control and statistically better than the 3 in. grind in terms of F:G, grinding through a 3 in. screen and treating was similar to feeding a control with only 5% stalks (Shreck et al., 2012b; Table 3). Regardless of grind size, treating stalks fed at 20% well outperformed native stalks for both ADG and F:G. We recommend a 3 in. grind, but there may be slight improvements to going even smaller although grinding costs and time increase. This is also dependent on moisture content of stalks.

Another question is whether the inclusion of wet or modified distillers grains matters relative to performance response. Peterson et al. (2014a) fed 10, 20, or 30% treated stalks in diets with either 20% or 40% MDGS. These data suggest that as treated stalks increase above 10% in diets with only 20% MDGS, ADG and F:G get linearly worse (Table 4). However, in diets with 40% MDGS, feeding 10 to 20% treated stalks maintains performance, which gets worse at 30% (quadratic response).

Table 3. Performance and carcass characteristics (Shreck et al. 2012b)

		1"Grindsize		3" Grindsize			Factorial P-value[2]	
Item	**Control**	**Treated**	**Untreated**	**Treated**	**Untreated**	**F-test**	**Grind[1]**	**Trt[1]**
Steer performance								
DMI, lb	24.01^{abc}	23.60^{bc}	24.50^{ab}	23.45^{c}	24.78^{a}	0.04	0.87	<0.01
ADG, lb	3.67^{a}	3.73^{a}	3.28^{b}	3.58^{a}	3.21^{b}	<0.01	0.02	<0.01
F:G	6.54^{ab}	6.32^{a}	7.47^{c}	6.55^{b}	7.72^{b}	<0.01	0.01	<0.01
Carcass characteristics								
HCW, lb	868^{a}	873^{a}	831^{b}	858^{a}	825^{b}	<0.01	0.26	<0.01
Dressing %	61.39	63.63	62.06	63.10	61.89	0.26	0.08	<0.01
12^{th} rib fat, in	0.57	0.55	0.51	0.56	0.52	0.24	0.51	0.07
Marbling[3]	595	568	546	590	579	0.11	0.07	0.27

[1] Fixed effect of grind size (1" vs 3") and fixed effect of chemical treatment
[2] No significant grind size x chemical treatment interaction was observed (P > 0.37); 3500=Small, 600=Modest
abc Within a row, values lacking common superscripts, differ, when F-test is significant (P<0.05)

Table 4. Performance of finishing cattle comparing the simple effects of 10, 20, or 30% alkaline treated stalks with either 20 or 40% MDGS along with the control diet that included 5% untreated stalks and 20% MDGS (Peterson et al., 2014a).

		20 distillers					40 distillers						P-values	
Item	Control	10	20	30	Lin[1]	Quad[2]	10	20	30	Lin[3]	Quad[4]	SEM	F-Test[5]	DxT[6]
Performance														
DMI, lb/d	23.5^{ab}	23.5^{ab}	23.8^{ab}	23.1^{b}	0.51	0.25	23.8^{ab}	24.2^{a}	24.3^{a}	0.34	0.70	0.32	0.18	0.47
ADG, lb	4.07^{ab}	3.90^{bc}	3.71^{cd}	3.32^{e}	<0.01	0.23	4.05^{ab}	4.13^{a}	3.63^{d}	<0.01	<0.01	0.07	<0.01	0.21
F:G	5.79^{a}	6.02^{b}	6.40^{c}	6.98^{d}	<0.01	0.54	5.89^{ab}	5.88^{ab}	6.70^{d}	<0.01	<0.01	-	<0.01	0.07
Carcass Characteristics														
HCW	907^{ab}	888^{bc}	868^{cd}	824^{e}	<0.01	0.24	905^{ab}	915^{a}	858^{d}	<0.01	<0.01	9	<0.01	0.26
Dressing, %	64.4^{a}	63.7^{bc}	63.1^{cd}	61.2^{e}	<0.01	0.05	64.1^{ab}	63.8^{ab}	62.5^{d}	<0.01	0.11	0.3	<0.01	0.21
LM area, in.^{2}	14.4^{a}	14.0^{ab}	14.2^{ab}	13.8^{b}	0.54	0.23	14.1^{ab}	14.5^{a}	14.0^{ab}	0.67	0.10	0.18	0.18	0.93
12th Rib fat, in.	0.58^{a}	0.53^{a}	0.46^{b}	0.39^{c}	<0.01	0.98	0.59^{a}	0.53^{a}	0.43^{bc}	<0.01	0.45	0.02	<0.01	0.74
Marbling[7]	459^{a}	488^{a}	488^{a}	470^{a}	0.30	0.53	476^{a}	462^{a}	463^{a}	0.44	0.62	13	0.42	0.31

[abcde] From the F-test, means lacking common superscripts, differ $P < 0.05$;
[1] Linear contrast for treated stalks within 20% MDGS inclusion
[2] Quadratic contrast for treated stalks within 20% MDGS inclusion;
[3] Linear contrast for treated stalks within 40% MDGS inclusion
[4] Quadratic contrast for treated stalks within 40% MDGS inclusion;
[5] Overall F-test statistic comparing the Control to all other treatments
[6] DxT is the distillers inclusion by alkaline treated stalks inclusion interaction;
[7] Marbling score where 400=Small^0

It is unclear the cause of the depression in ADG observed in this commercial study and in one of the 5 experiments conducted at UNL where feeding 20% treated stalks did not result in similar performance. Interestingly, both studies where equal performance was not observed were conducted with yearlings fed in the summer and resulted in a 6.7% increase in F:G (Johnson et al., 2013) or a 5.4% increase (Cooper et al., 2014) in F:G when steers were fed TRT compared to CON. It is unclear if cattle type, season, or some other variable impacts cattle performance when replacing corn with alkaline treated stalks. Table 5 provides an overview of the feedlot studies conducted where similar treatments were fed. Across studies, two showed no difference, three showed that treated stalks were poorer, and two studies showed numerical improvements but that was due to grind size in one of them. One of the studies that were poorer response to treated stalks was due to only 20% inclusion of MDGS.

In studies that included 20% stalks that were not treated, performance was dramatically worse with 10 to 20% increases in F:G for cattle, which illustrates that you cannot just increase stalk inclusion and get similar performance.

Table 5. Summary of F:G across experiments with 20% treated stalks (TRT) compared to a 5% stalks control (CON) or not treating (NONTRT).

	Treatments			CON vs TRT		CON vs NONTRT
	CON	TRT	NONTRT	DIFF	% DIFF	% DIFF
Johnson calf	6.36[a]	7.05[b]	6.22[a]	-0.14	-2.2%	10.8%
Johnson yrlgs	6.42[a]	7.65[b]	6.85[c]	0.43	6.7%	19.2%
Shreck 3"	6.54	6.55	7.72	0.01	0.2%	18.0%
Shreck 1"	6.54	6.32	7.47	-0.22	-3.4%	14.2%
Peterson 20%	5.79	6.40	-	0.61	10.5%	-
Peterson 40%	5.79	5.88	-	0.09	1.6%	-
Cooper	5.53	5.83	-	0.30	5.4%	-

These data suggest when treated residue gets above 20% of the diet, performance may be hindered and cattle consuming all the residue is likely a challenge. Our conclusions are to only include up to 20% treated residue, at least 25% corn (Shreck et al., 2013a), and at least 35 to 40% wet or modified distillers grains. All of our studies have been completed with either wet or modified distillers grains plus solubles, so it is not clear what the impact would be with dry distillers grains plus solubles. Likewise, other corn processing methods besides high-moisture and dry-rolled corn may impact these results too, but doesn't really apply to this situation. At best, feeding treated stalks at 20% compared to traditional inclusions will give similar ADG and conversions. At worst, a 5 to 6% increase in feed conversion is possible. These risks should be taken into consideration when performing economics.

Lastly, many questions have been asked about use for backgrounding cattle or growing cattle. We have completed two studies (Peterson et al., 2014b; Shreck et al., 2014) and would suggest that it is not economical to treat stalks for growing cattle simply because the energy is not increased sufficiently in the diet to justify the costs. In these two studies, we included large amounts of treated stalks (60 to 70% of the diet). Treating stalks increased intake (probably due to greater ruminal digestion and subsequently passage rate), increased ADG, but did not dramatically impact the feed conversion (Table 6, Table 7). Our future research focus will include decreasing particle size (pelleting) and other potential treatments.

Table 6. Effect of crop residue and alkaline treatment on growing steer performance (Shreck et al., 2014).

	Corn stover		Wheat straw					
Item	Treated	Untreated	Treated	Untreated	SEM	CaO[1]	Residue[2]	CaO x Residue
Initial BW	729	729	728	727	0.64	0.59	0.43	0.19
Ending BW	844[b]	834[c]	868[a]	841[b]	2.60	<0.01	<0.01	<0.01
ADG	1.67[b]	1.52[c]	2.02[a]	1.63[bc]	0.04	<0.01	<0.01	<0.01
DMI	16.7	15.7	18.7	16.4	0.43	<0.01	<0.01	0.15
F:G	10.00	10.32	9.25	10.06	-	0.06	0.07	0.18

[1] Main effect of CaO + water or none
[2] Main effect of residue type (corn stover or wheat straw)
[3] Average profit/hd relative to untreated crop residue
[abc] Within a row, means lacking common superscripts differ, when interaction P < 0.05

Table 7. Effects of pelleting (Iowa Agricultural BioFibers) and chemical treatment on cattle performance (Peterson et al., 2014b).

	Pelleted		Not Pelleted			P-values		
Item	Untreated	$Ca(OH)_2$	Untreated	CaO	SEM	Pellet[1]	T[2]	PxT[3]
Initial BW, lb	688	689	688	688	1	0.49	0.49	0.82
Ending BW, lb	926	954	907	927	5	<0.01	<0.01	0.47
ADG, lb	2.97	3.31	2.74	2.99	0.06	<0.01	<0.01	0.44
DMI, lb/day	26.1	27.4	20.7	22.2	0.2	<0.01	<0.01	0.58
Feed:Gain[4]	8.80	8.29	7.55	7.46	-	<0.01	0.05	0.18

[1] Fixed effect of pelleting
[2] Fixed effect of CaO or Ca(OH)2 treatment
[3] Pellet x CaO/Ca(OH)2 treatment interaction
[4] Statistics calculated on Gain:Feed

Corn silage

With increase price of corn grain, corn silage may be a more economical feed to replace a portion of the corn grain in beef finishing diets. Research 40 years ago focused on the impact of different corn silage to corn grain ratios. It was not uncommon in that time period to finish cattle on corn silage-based diets. A summary done by the University of Minnesota suggested that silage could be fed at 40 to 60% inclusion and still be economical, although feed conversion is elevated.

With the increased usage of distillers grains, our questions were whether this research area needed to be revisited. Three feedlot experiments have focused on feeding elevated amounts of corn silage (varying) in diets with distillers grains (varying). In the first experiment, we fed 15, 30, 45 or 55% corn silage with diets that contained 40% distillers grains and two additional diets with 45% corn silage and no distillers and 30% corn silage with 65% MDGS (Burken et al., 2013a). As corn silage increased in the diet within diets containing 40% MDGS, ADG decreased linearly and F:G increases linearly (Table 8). Within diets containing 45% silage, feeding 40% MDGS resulted in better ADG and F:G compared to feeding corn as you would expect. We concluded that feeding more (i.e., 30 to 45%) than traditional amounts of silage (i.e., 15%) may be economical (Burken et al., 2013b) despite slightly lower ADG and poorer F:G. This study design does not really answer though whether feeding greater amounts of silage works better today (with distillers in the diet) compared to historical data.

Two additional experiments were conducted with exactly the same treatment design. The first one was with fall yearlings that were large when they started and fed during some inclimate weather (Burken et al., 2014). The second experiment was conducted over the summer with summer-fed yearlings (Burken, unpublished data). The treatment design was five treatments designed as a 2×2 plus 1 factorial. We fed either 15 or 45% corn silage in diets with either 20 or 40% corn silage along with a control diet that contained 40% MDGS and 5% corn stalks. In the first experiment, cattle fed the control performed similarly to the 40% MDGS with 15% corn silage suggesting the roughage source (stalks or silage) did not impact performance (Table 9). Feeding 45% silage decreased ADG and increased F:G compared to feeding 15%. However, the change in ADG and F:G was less when diets contained 40% MDGS as compared to 20% inclusion of MDGS.

In the second experiment with the same design, steers fed the control diet had numerically lower ADG and greater F:G compared to cattle fed 15% silage along with 40% MDGS suggesting that stalks were not as good of a roughage source as the corn silage. Steers fed 45% silage ate more than cattle fed 15% silage (Table 10) regardless of MDGS inclusion. Steers also gained less when fed 45% silage at both inclusions of MDGS as compared to 15% silage and so F:G was greater or poorer when silage was increased. However, no interaction was observed between silage inclusion and MDGS inclusion. Feeding 45% corn silage with 40% MDGS increased F:G by 5.4% compared to 15% silage in diets with 20% MDGS. Feeding 45% corn silage with 20% MDGS increased F:G by 5.9% compared to 15% silage, or about the same amount.

Should feeders use more than 15% corn silage to replace expensive grain? The answer to this question depends on economics. Much of the previous work on feeding silage used incorrect economics. How silage is priced relative to corn grain is quite complex and will be discussed. The data suggest that if we can ensile drier silage without a yield drag and without increased shrink, then feeding elevated amounts of silage (i.e., greater than 15%, perhaps 30 to 40% inclusion) is economical when grain is above $3.50 per bushel.

Table 8. Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics (Burken et al., 2013a).

	Treatment[1]						P-value[2]			
	15:40	30:40	45:40	55:40	30:65	45:0	Lin.	Quad.	30	45
DMI, lb/day	23.15	22.77	22.70	21.92	21.66	22.26	0.01	0.45	0.01	0.30
ADG, lb[3]	4.04	3.92	3.76	3.53	3.62	3.55	<0.01	0.19	<0.01	0.02
Feed:Gain	5.73	5.81	6.03	6.21	5.98	6.28	<0.01	0.33	0.12	0.04
12th-rib fat, in	0.55	0.53	0.52	0.43	0.50	0.49	<0.01	0.09	0.29	0.29
Marbling Score[4]	556	557	543	532	547	539	0.13	0.52	0.55	0.85

[1] 15:40= 15% Corn Silage, 40% MDGS; 30:40= 30% Corn Silage, 40% MDGS; 45:40= 45% Corn Silage, 40% MDGS; 55:40= 55% Corn Silage, 40% MDGS; 30:65= 30% Corn Silage, 65% MDGS; 45:0= 45% Corn Silage, 0% MDGS.

[2] Lin. = P-value for the linear response to corn silage inclusion, Quad.= P-value for the quadratic response to corn silage inclusion, 30 = t-test comparison of treatments 30:40 and 30:65, 45 = t-test comparison of treatments 45:40 and 45:0.

[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage.

[4] Marbling Score: 400=Slight00, 500=Small00.

Table 9. Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics with large yearlings (Burken et al., 2014).

	Treatment[1]					P-value[2]			
	Control	15:20	15:40	45:20	45:40	F-test	Int.	Silage	MDGS
DMI, lb/day	29.1	29.5	28.7	29.5	29.8	0.48	0.24	0.34	0.47
ADG, lb[3]	3.70[ab]	3.95[a]	3.64[b]	3.44[b]	3.62[b]	0.09	0.08	0.06	0.59
Feed:Gain[3]	7.87[ab]	7.46[a]	7.87[ab]	8.55[c]	8.20[bc]	0.01	0.08	<0.01	0.71
HCW, lb	864	877	858	849	858	0.12	0.09	0.08	0.57
12th-rib fat, in	0.47	0.47	0.50	0.47	0.48	0.65	0.82	0.65	0.20
Marbling Score[4]	540[b]	583[a]	548[b]	554[b]	532[b]	0.03	0.54	0.05	0.02

[1] 15:20 = 15% Corn Silage, 20% MDGS; 15:40 = 15% Corn Silage, 40% MDGS; 45:20 = 45% Corn Silage, 20% MDGS; 45:40 = 45% Corn Silage, 40% MDGS

[2] F-test= P-value for the overall F-test of all diets. Int. = P-value for the interaction of corn silage X MDGS. Silage = P-value for the main effect of corn silage inclusion. MDGS = P-value for the main effect of MDGS inclusion.

[3] Calculated from hot carcass weight, adjusted to a common 62% dressing percentage.

[4] Marbling Score: 400=Slight00, 500=Small00.

[abcd] Within a row, values lacking common superscripts differ ($P < 0.10$).

Table 10. Effect of corn silage and MDGS inclusion on cattle performance and carcass characteristics with summer yearlings (Burken et al., unpublished; 2015 Beef Report).

	Treatment[1]					P-value[2]			
	Control	15:20	15:40	45:20	45:40	F-test	Int.	Silage	MDGS
Performance									
DMI, lb/day	27.6	26.5	26.8	27.3	27.1	0.13	0.41	0.08	0.86
ADG, lb[3]	4.69	4.62	4.79	4.54	4.58	0.11	0.19	0.01	0.06
Feed:Gain[3]	5.88[bc]	5.71[ab]	5.59[a]	6.02[c]	5.92[c]	<0.01	0.63	<0.01	0.09
Carcass Characteristics									
HCW, lb	893	887	898	879	882	0.18	0.41	0.02	0.13
LM area, in^2	13.2	13.2	13.1	13.2	12.8	0.62	0.39	0.38	0.16
12th-rib fat, in	0.66	0.64	0.70	0.64	0.64	0.43	0.27	0.24	0.26
Calculated YG	3.83	3.75	3.98	3.71	3.85	0.54	0.66	0.44	0.10
Marbling Score[4]	450	437	459	454	431	0.74	0.12	0.72	0.98

[1] 15:20 = 15% Corn Silage, 20% MDGS; 15:40 = 15% Corn Silage, 40% MDGS; 45:20 = 45% Corn Silage, 20% MDGS; 45:40 = 45% Corn Silage, 40% MDGS

[2] F-test= P-value for the overall F-test of all diets. Int. = P-value for the interaction of corn silage X MDGS. Silage = P-value for the main effect of corn silage inclusion. MDGS = P-value for the main effect of MDGS inclusion.

[3] Calculated from hot carcass weight, adjusted to a common 63% dressing percentage.

[4] Marbling Score: 400=Slight00, 500=Small00.

[abcd] Within a row, values lacking common superscripts differ ($P < 0.10$).

For more information on our research in both of these areas, please visit our beef website (beef.unl.edu). We hosted a UNL Extension meeting at our Ag Research and Development Center near Mead, NE on June 20, 2012 focused on residue usage. This meeting was archived so presentations and slides are available at http://beef.unl.edu/cornresidues for the direct link. All of these data are available in the Nebraska Beef Reports which can be accessed at: http://beef.unl.edu under "reports" at the top of the page. In addition, numerous live webinars are available at the beef website on corn silage use, shrink and storage, and economics.

Specific citations from beef reports

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